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Three *Rinodina* species new to China

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Abstract—*Rinodina ascociscana*, *R. subminuta*, and *R. trevisanii* are reported as new to China. A detailed description of each species is provided, and comparisons with related species are made.

Key words—*Ascomycota,* lichenized fungi, *Physciaceae*

Introduction

Rinodina (*Physciaceae*, *Caliciales*), which comprises more than 300 species worldwide (Sheard & al. 2017), occurs on rock, bark, mosses, soil, or debris and is characterized by a crustose thallus, mostly lecanorine apothecia with brown to black discs, a hyaline hymenium, a red-brown or (rarely) blue-grey epihymenium, clavate asci, and brown, primarily 1-septate (rarely 3-septate) to submuriform ascospores with ± unequally thickened walls (Mayrhofer & Moberg 2002; Sheard 2004, 2010).

Although many have recently contributed to crustose lichen diversity in China (e.g., Kou & al. 2013, Ren & Zhao 2014, Ren 2017, Ren & al. 2018, Zhou & Ren 2018), knowledge of *Rinodina* species remains poor in this country. Forty-five species and three forms have been reported from China (e.g., Mayrhofer 1984; Wei 1991; Abdulla & Wu 1994, 1998; Aptroot & Seaward 1999; Aptroot & Sipman 2001; Aptroot & Sparrius 2003; Joshi & al. 2014; Kondratyuk & al. 2016; Sheard & al. 2017). During a survey of *Rinodina* specimens, we detected three species new for China: *Rinodina ascociscana*, *R. subminuta*, and *R. trevisanii.*

Materials & methods

The specimens examined in this study were housed in SDNU (the Plant Herbarium of Shandong Normal University, Jinan, China) and HMAS-L (Herbarium of Mycology, Chinese Academy of Sciences, Beijing, China).

Morphological and anatomical characters were observed using an Olympus SZ51 stereo microscope and an Olympus CX21 light microscope. Lichen substances were detected by thin layer chromatography (TLC) with solvent systems A, B,, and C (Elix 2014). Photos were taken using Olympus SZX16 and BX61 microscopes with a DP72 digital camera. We identified the specimens primarily from Sheard & al. (2017).

Species

Rinodina ascociscana (Tuck.) Tuck., Gen. Lich.: 124 (1872). Fig. 1

Thallus crustose, thick, well-developed, surface continuous, ochraceous to brownish; prothallus absent; vegetative propagules absent.

Apothecia lecanorine, not erumpent, 0.5–1.2 mm in diam, scattered, sessile, narrowly attached; disc brown to black, epruinose, persistently plane, thalline margin concolourous with thallus, often with radially cracked, sometimes becoming flexuous; excipular ring present, confluent, prominent, darker than thalline margin. Thalline exciple 50–80 µm wide; proper exciple hyaline, 15–25 µm wide; hymenium hyaline, 80–110 µm high, paraphyses 2–3 µm in diam.; epihymenium red-brown, 10–20 µm high; hypothecium hyaline, 20–40 µm deep. Asci clavate, 8-spored; ascospores brown to dark brown, type A development, *Physcia*-type, ellipsoid, 1-septate, 27.5–35 × 12.5–15 µm, torus absent, ornamented walls not evident. Pycnidia not seen.

Chemistry—No lichen substances detected by TLC.

Specimens examined: **CHINA. Jilin: Antu County**, c. 30 km from Erdaobaihe town toward Changbaishan mountain and lake, alt. c. 1100 m, on bark of conifer tree, 2011.09, Sohrabi with Ghobad-Nejhad 16644 (HAMS-L 120853); **Helong City**, Mt. Zengfeng, alt. 1600 m, on bark of deciduous trees, 2011.08.19, Y.L. Cheng 20119406A, 20119440B, 20119844 (SDNU).

Substrate & distribution—*Rinodina ascociscana* occurs on bark of conifers or deciduous trees in mixed forests with *Acer*, *Abies*, and *Larix*. It was previously known from North America (Sheard 2010) and north-eastern Asia (Japan, Siberia, and South Korea; Sheard & al. 2017); new from China.

Comments—Our material closely matched the descriptions of Sheard (2010) and Sheard & al. (2017). *Rinodina ascociscana* is characterized by the often radially cracked thalline margin, the large *Physcia*-type ascospores

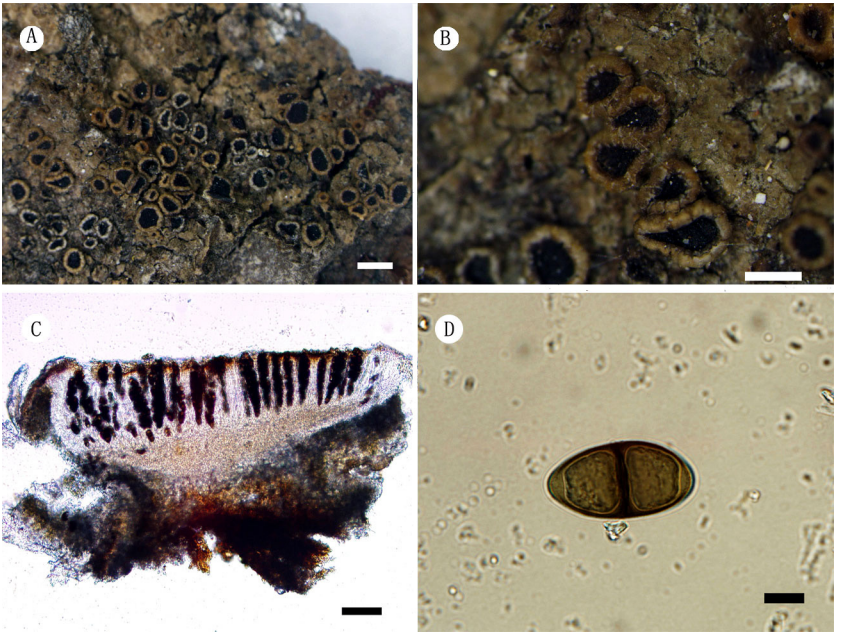

Fig. 1. *Rinodina ascociscana* (SDNU, Cheng 20119844). A. Thallus with substratum; B. Apothecia showing radially cracked thalline margin; C. Section of apothecium; D. Immature *Physcia*-type ascospore; E. *Physcia*-type ascospore mature. Scale bars: A = 1 mm; B = 0.5 mm; C = 100 µm; D, E = 10 µm.

with type A development, and the absence of lichen substances. *Rinodina dolichospora* Malme differs by its thalline margin that is not radially cracked and *Pachysporaria*-type I ascospores (Sheard 2010).

Rinodina subminuta H. Magn., Bot. Not. 1947: 44 (1947). Fig. 2

Thallus crustose, thin to endophloeodal, continuous to rimose, surface matte or glossy, yellowish or light to dark grey; prothallus absent; vegetative propagules absent.

Apothecia lecanorine, erumpent; disc black, epruinose, plane, sometimes convex, 0.4–0.65 mm in diam; thalline margin concolourous with thallus, excipular ring absent. Thalline exciple 50–80 µm wide; proper exciple hyaline, 15–25 µm wide; hymenium hyaline, 60–80 µm high, paraphyses 2.5–4.5 µm in diam.; epihymenium red-brown; hypothecium hyaline, 30–60 µm deep. Asci clavate, 8-spored, 45–70 × 20–30 µm;

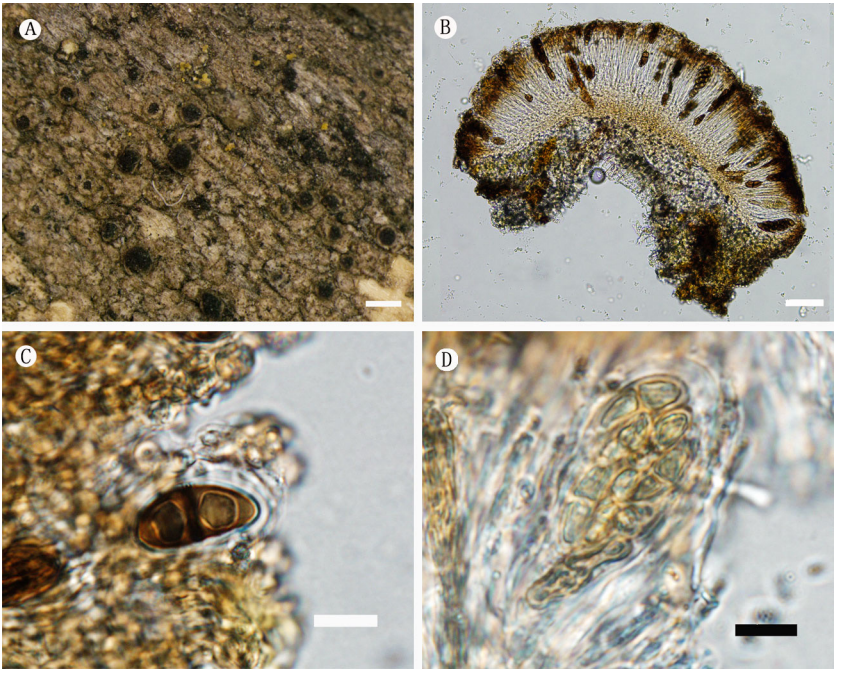

Fig. 2. *Rinodina subminuta* (HMAS-L 073131). A. Thallus with substratum; B. Section of apothecium; C. Mature ascospore. Scale bars: A = 0.5 mm; B = 50 µm; C = 10 µm.

ascospores brown, type A development, ellipsoid, 1-septate, *Physcia*-type, 17–20(–22.5) × 8–9.5(–10) µm, torus present, ascospore walls not ornamented. Pycnidia not seen.

Chemistry—Zeorin, ± one unknown substance with UV+ blue (TLC: A=7, B=7, C=7).

Specimens examined: **CHINA. Jilin: Mt. Changbai**, Tianchi, alt. 1850 m, on *Betula ermanii* Cham. (*Betulaceae*), 1984.08.14, X.D. Lu 848410-1 (HMAS-L 0141286); Hot spring, on *Betula ermanii*, 1994.08.06, Wei & al. 94423 (HMAS-L 073131); South Slope, alt. 1900 m, on *Betula ermanii*, 1983.08.03, J.C. Wei & J.B. Chen 6586-1 (HMAS-L 0141288); on *Betula ermanii*, 2003.8.20, H.M. Li CBS114-1 (HMAS-L 0141273); North Slope, alt. 1810 m. on *Sorbus* sp. (*Rosaceae*), 2018.08.19, Q. Ren 7119, 7120 (SDNU); on *Betula ermanii*, 2018.08.19, Q. Ren 7029, 7040 (SDNU).

Substrate & distribution—*Rinodina subminuta* occurs on the bark of *Betula ermanii* and *Sorbus* sp. in open sites of deciduous forests. It was previously known from North America and Siberia (Sheard 2010), and from north-eastern Asia (Japan, Siberia, and South Korea; Sheard & al. 2017); new from China.

Comments—Our material closely matches the description in Sheard (2010). *Rinodina subminuta* is characterized by a thin thallus, erumpent apothecia, *Physcia*-type ascospores with type A development, and the presence of zeorin. *Rinodina orientalis* Sheard differs by strongly convex discs of mature apothecia, smaller ascospores (16–18 × 7–8.5 μm), and the absence of lichen substances (Sheard & al. 2017).

Rinodina trevisanii (Hepp) Körb., Parerga Lichenol.: 70 (1859) Fig. 3

Thallus crustose, very thin, surface continuous to rimose, brownish; prothallus absent; vegetative propagules absent.

Apothecia lecanorine, not erumpent, 0.4–0.6 mm in diam, sessile, broadly or narrowly attached; disc brown to black, epruinose, plane, frequently becoming convex, thalline margin concolourous with thallus, often becoming excluded or margin biatorine, excipular ring not prominent. Thalline exciple 50–70 μm wide; proper exciple hyaline, c. 15 μm wide; hymenium hyaline, 65–80 μm high, paraphyses 1.5–2.5 μm in diam.; epihymenium red-brown, 10–30 μm high; hypothecium hyaline, 30–110 μm deep. Asci clavate, 8-spored, 50–60 × 17.5–30 μm; ascospores brown, type A development, *Physconia*-type, ellipsoid, 1-septate, 18–22.5(–23.5) × 8–9.5(–10) μm, torus sometimes present but not prominent, ascospore walls not ornamented. Pycnidia not seen.

Chemistry—±Zeorin.

Specimens examined: **CHINA. Heilongjiang: Heihe City**, Mt. Xifeng, alt. 220 m, on bark, 2009.08.17, Q. Ren 1192 (SDNU); **Mohe City**, Mt. Guanyinshan, alt. 554 m, on bark, 2009.08.13, Q. Ren 1179 (SDNU); **Tahe City**, Mt. Baikalu, alt. 800 m, on bark, 2011.08.25, Y.L. Cheng 20125237B (SDNU); Daxing'anling, alt. 800 m, on tree trunk, 1984.08.07, X.Q. Gao 105 (HMAS-L 072400). **Jilin: Antu City**, Mt. Changbai, alt. 1750 m, on *Larix* sp. (*Pinaceae*), 1984.08.28, X.D. Lu 848421-5 (HMAS-L 076349); North Slope of Mt. Changbai, alt. 1810 m. on *Betula ermanii*, 2018.08.19, Q. Ren 7118 (SDNU).

Substrate & distribution— *Rinodina trevisanii* occurs on bark of *Larix* sp., *Betula ermanii*, and other trees in mixed forests. It was previously known from Europe, Asia (Caucasus, Turkey, Siberia), western North America (Mayrhofer & Sheard 2007, Sheard 2010), Kazakhstan (Hauck & al. 2013a), and western Mongolia (Hauck & al. 2013b); new from China.

Comments—Our material closely corresponds with the description of Sheard (2010). *Rinodina trevisanii* is characterized by a thin thallus, mostly scattered apothecia with frequently convex discs and margins often biatorine, and *Physconia*-type ascospores with type A development. *Rinodina archaea*

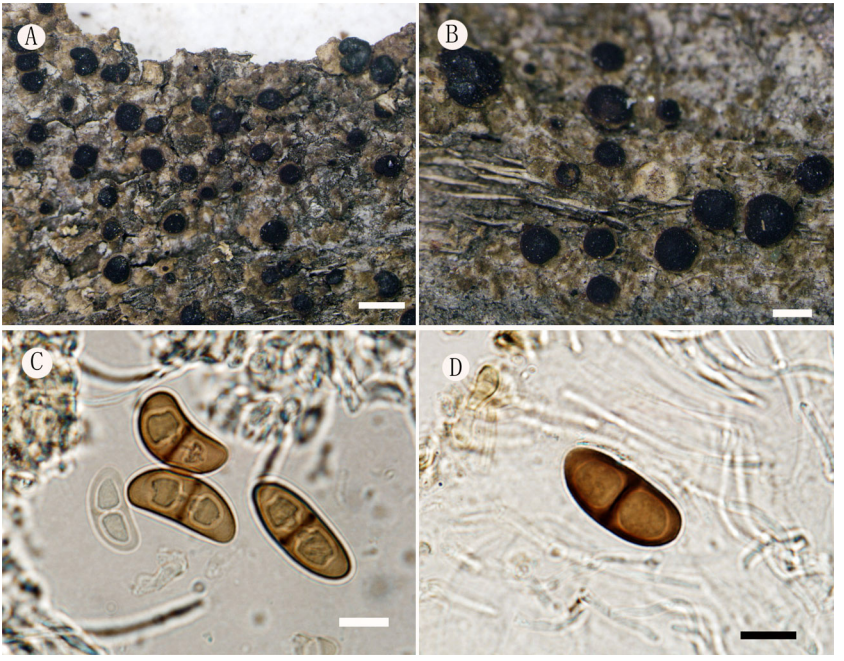

Fig. 3. *Rinodina trevisanii* (HMAS-L 076349). A, B. Thallus with substratum; C. Immature ascospores; D. Mature ascospore. Scale bars: A = 1 mm; B = 0.5 mm; C, D = 10 μm.

(Ach.) Arnold differs by its relatively thick, typically areolate thallus, often compressed (hence angular) apothecia, persistently plane discs of mature apothecia, and larger ascospores (Mayrhofer & Sheard 2007).

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